2015-16 Winter Outlook for Central & Northern New Mexico

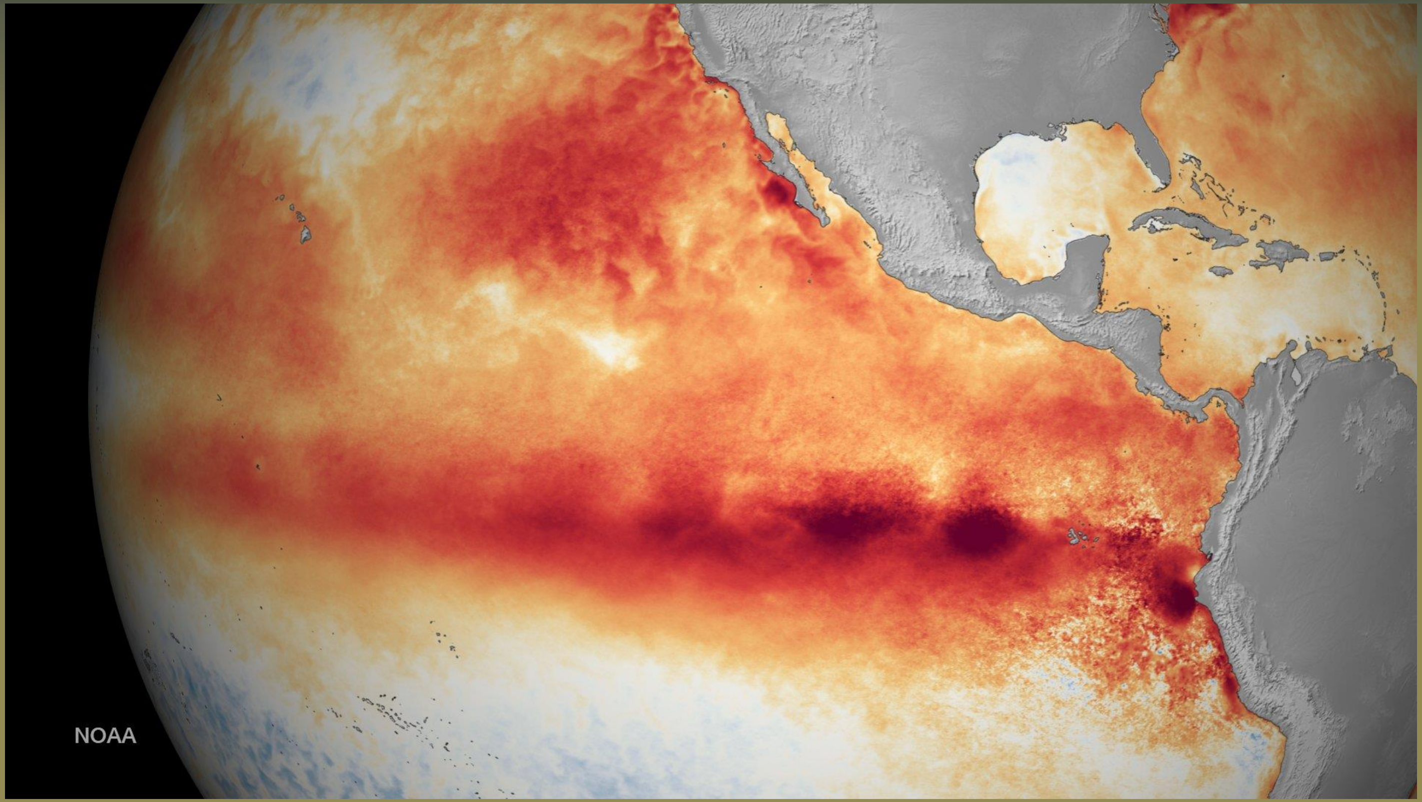


Figure 1. Sea Surface Temperature anomalies in the Pacific Ocean between August 31 and September 6, 2015. Red color depicts above average temperatures and blue color depicts below average temperatures.

Compared to July-August, the updated August-September Multivariate ENSO Index (MEI) has increased to +2.53, or the 2nd highest ranking, surpassed only in 1997 at this time of year. This new peak value of the current event ranks third highest overall at any time of year since 1950, closing in on 1982-83 and 1997-98 with 'Super El Niño' values around +3 standard deviations (K. Wolter). <u>How will one of the strongest El Niño events in recorded history affect winter (Dec, Jan & Feb) precipitation in central and northern New Mexico?</u>

Latest Sea Surface Temperature Observations & Oscillation Index Values

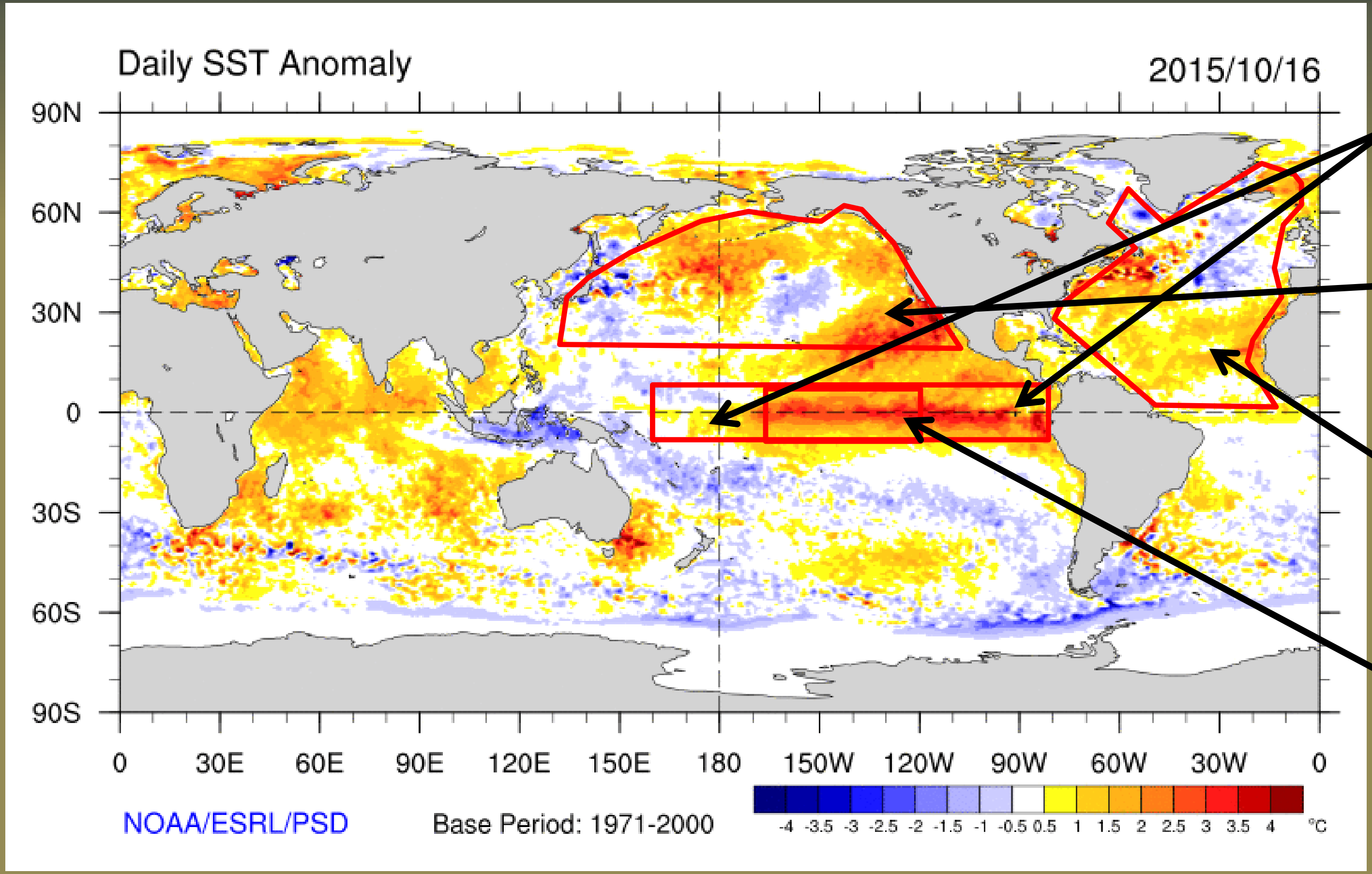


Figure 2. SST Anomalies in the Equatorial Pacific Ocean in mid October 2015 showing a very strong to extreme El Niño is underway.

- Multivariate ENSO Index (MEI) for AUG-SEP 2015: +**2.53**
- Pacific Decadal Oscillation (PDO) for SEP 2015: +**1.94**
- Atlantic Multidecadal Oscillation (AMO) for SEP 2015: +**0.32**
- Oceanic Niño Index (ONI) (uses Niño 3.4 region - inner rectangle) for JAS 2015: +**1.5**

2015 El Niño vs. the Strongest El Niño events since 1950

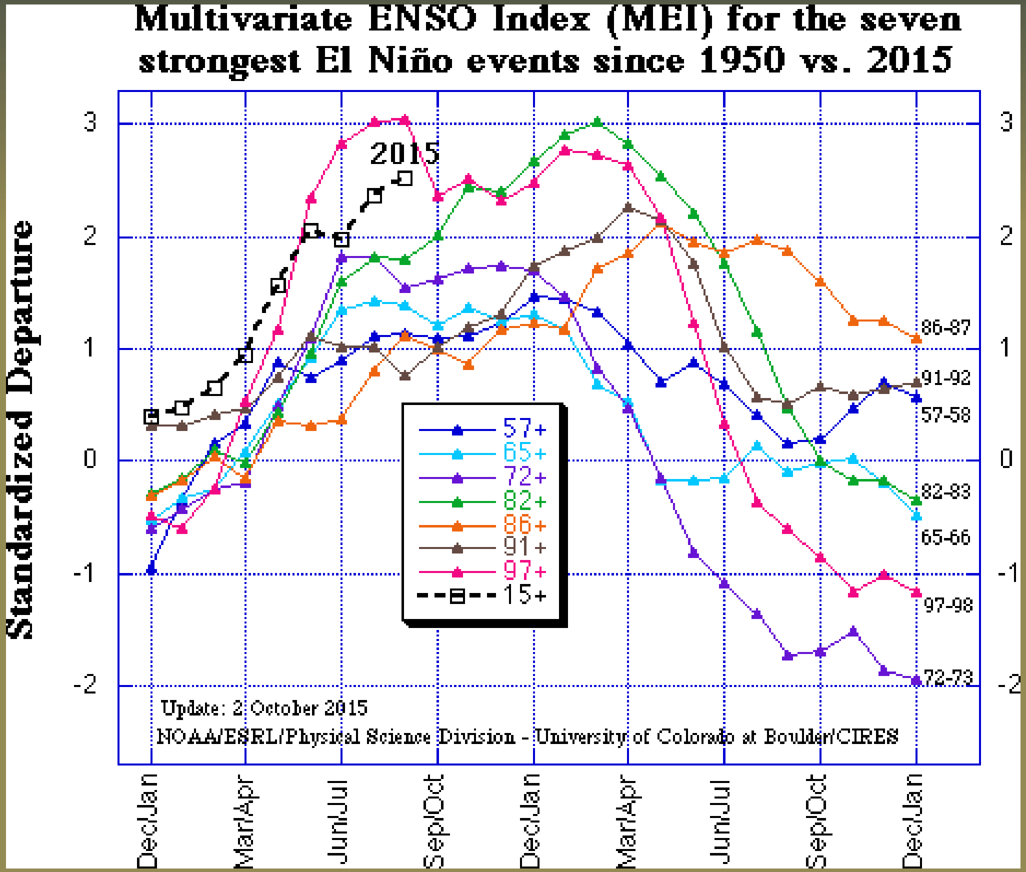
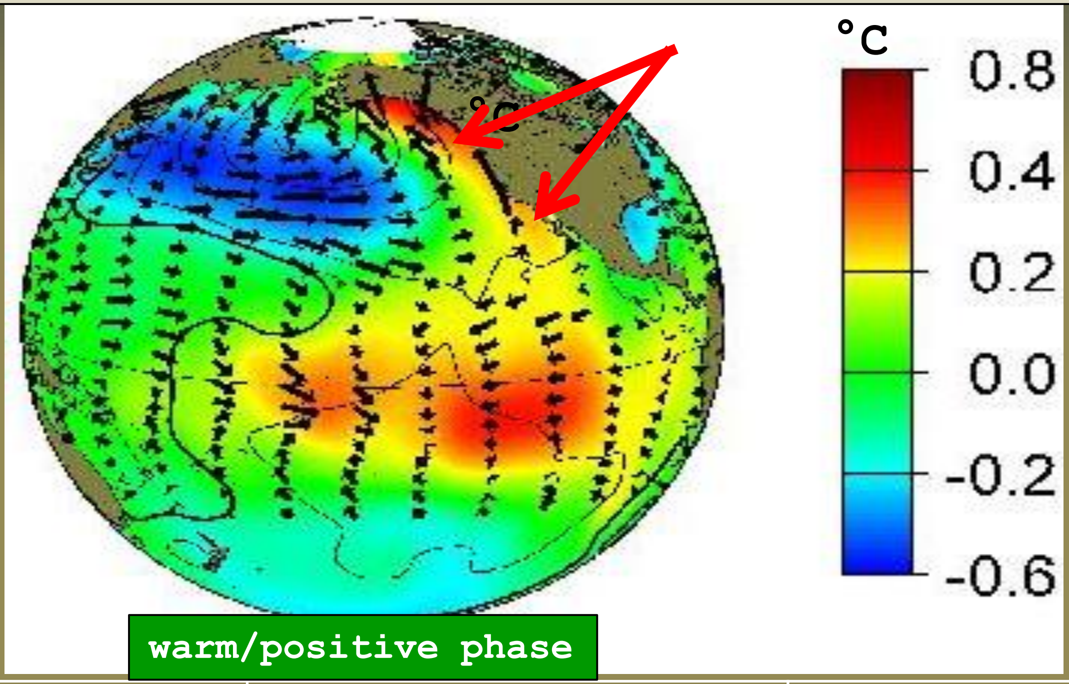


Figure 3. Seven strongest El Niño events using the Multivariate El Niño Southern Oscillation Index since 1950. 1957-58, 1972-73, 1982-83 and 1997-98 were chosen as analog years based on not only MEI values but also whether or not a positive Pacific Decadal Oscillation (PDO) was present.

The Pacific Decadal Oscillation (PDO)

A key factor during a positive PDO is increased low and mid level moisture availability in far northeast Pacific/Gulf of CA.

What's been referred to in the media as "The Blob" (a large area of warm ocean temperatures off the West Coast of the U.S) is associated with the sea surface temperature pattern during the positive/warm phase of the PDO.



PDO Jul, Aug, Sep 2015	PDO Jul, Aug, Sep 1997	PDO Jul, Aug, Sep 1982	PDO Jul, Aug, Sep 1972	PDO Jul, Aug, Sep 1957
1.84, 1.56, 1.94	2.35, 2.79, 2.19	*-0.58, 0.39, 0.84*	*-0.83, 0.25, 0.17*	*0.72, 0.51, 1.59*

Figure 4. Typical Sea Surface Temperature Anomaly (SSTA) patterns and wind stress or the amount of wind force on the water surface (arrows) in the North Pacific Ocean during a positive Pacific Decadal Oscillation phase (PDO). As with El Niño, the PDO correlates well with winter precipitation in the southwest United States.

Atmospheric Response to Warmer than Average SSTs

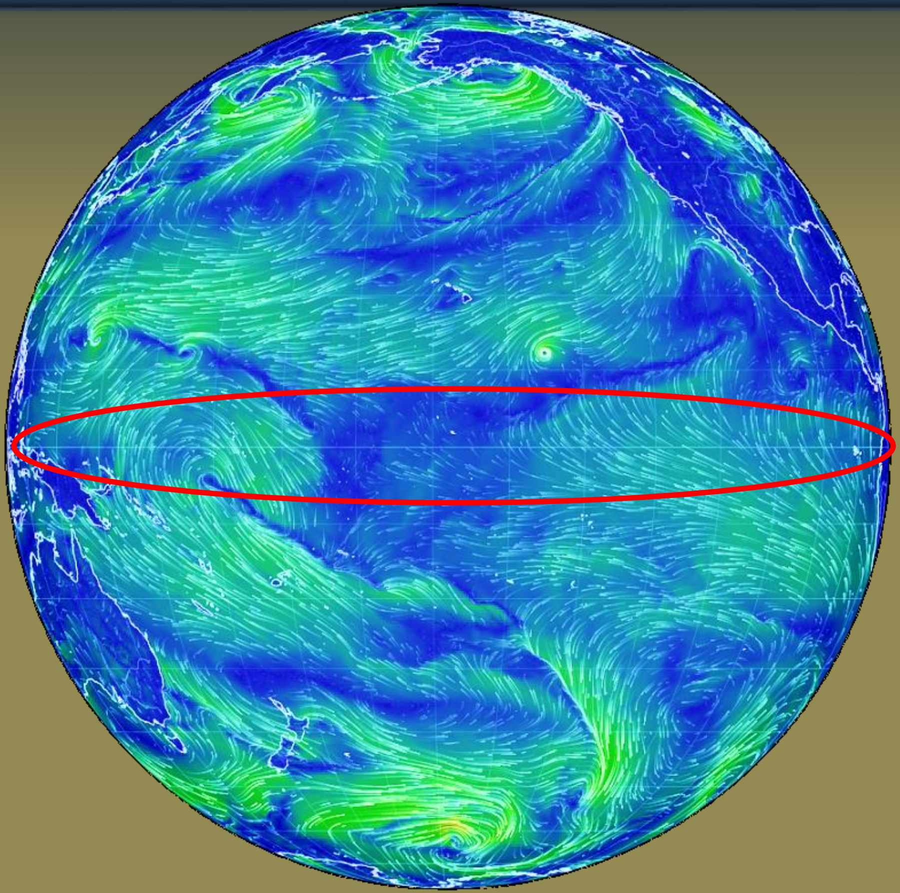


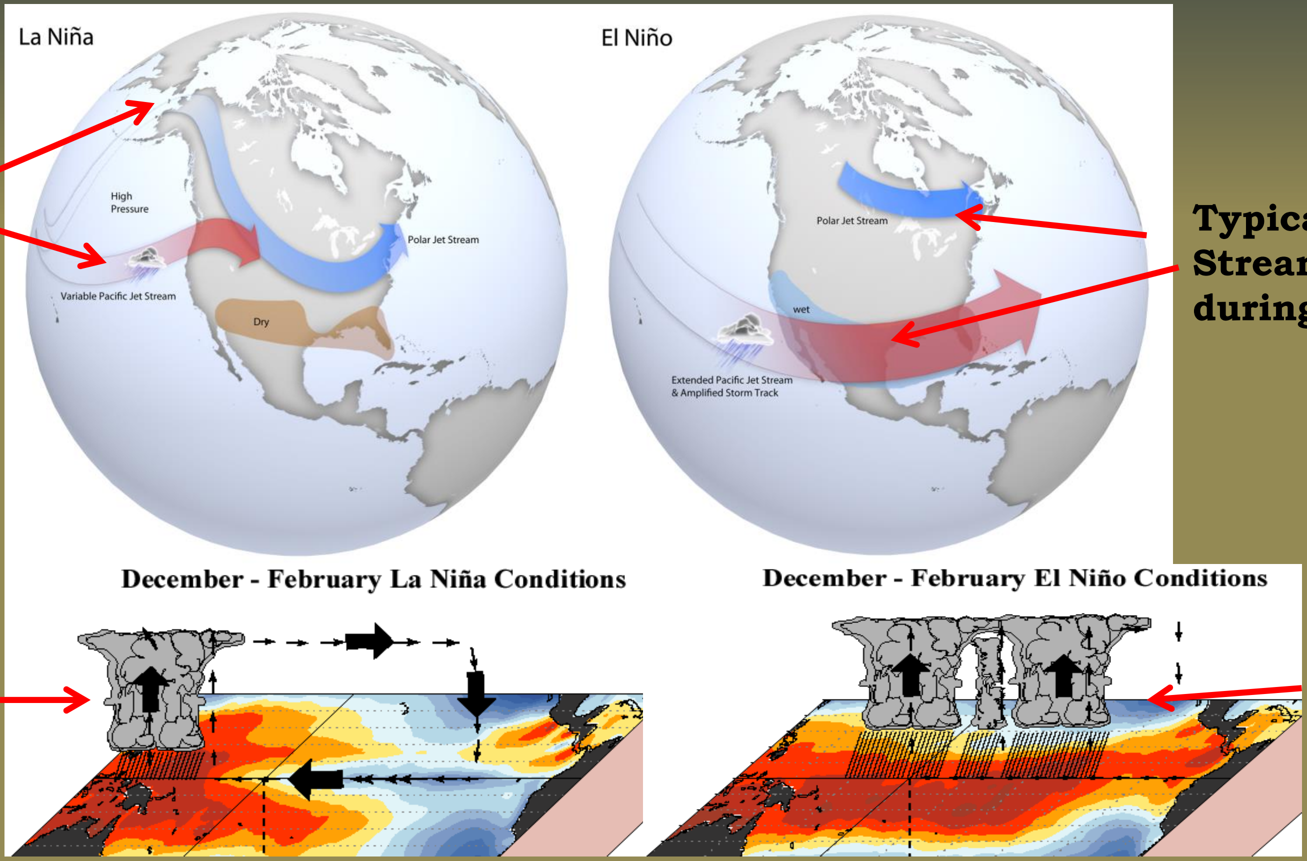
Figure 5. Surface wind observations from 10/12/15 (CloudFare).

Near-surface winds along the equator in the Pacific, which are important for maintaining the sea surface temperature anomalies, have lagged a bit behind the strongest two El Niño events so far. These winds, which blow from east to west under normal conditions, weaken during El Niño, allowing the warmer water in the western Pacific to move into the central and eastern regions. In 1997-98, the strongest event on record, the winds in the central Pacific weakened so much they reversed, and blew from west to east during October and November. September 2015 had consistently weaker-than-average winds and October started off with a strong westerly wind burst.

So What if SSTs in the Eastern Pacific Ocean Are Warmer to Much Warmer Than Average?

Typical Jet Stream Pattern during La Niña

Typical Jet Stream Pattern during El Niño



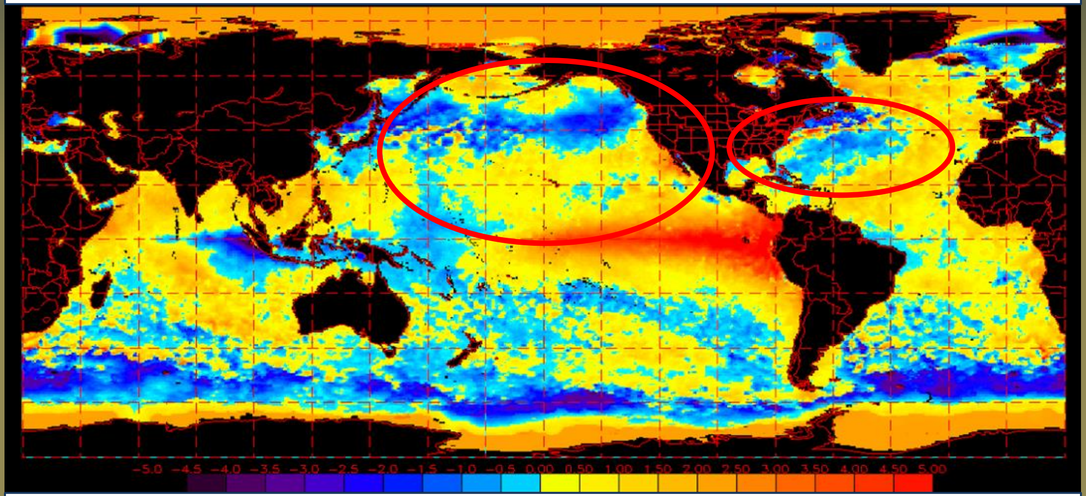
Typical Tropical circulations during La Niña

Typical Tropical circulations during El Niño

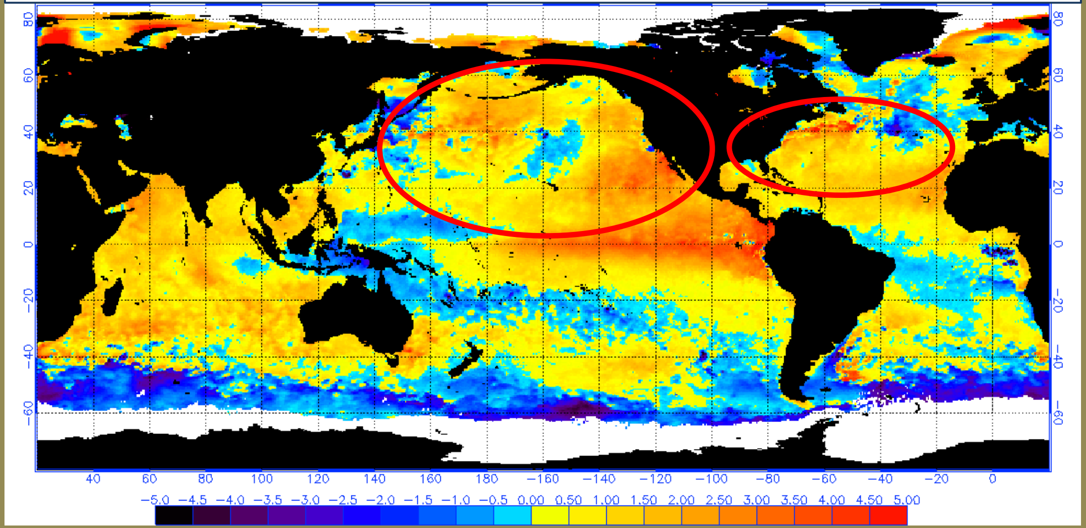
Figure 6. Warmer SSTs support deep tropical and subtropical convection farther east than average. This deep convection allows the jet stream to penetrate farther eastward into the far eastern Pacific Ocean and western United States. The jet stream is the result of large temperature differences between tropical and subtropical convection and colder air aloft toward the poles. In other words, more deep convection farther east in the Pacific Ocean Basin typically equates to greater chances that the jet stream/storm track will move over New Mexico.

Comparing mid Oct 1997 Global SSTAs to mid Oct 2015

Global SSTA's 10/18/1997



Global SSTA's 10/19/2015



Figures 7 & 8. SSTAs from the closest analog year, 1997, and current conditions. Note the differences between the northeast Pacific and North Atlantic SSTA distribution.

DJF Snowfall – Analog Years vs. 30-yr Average

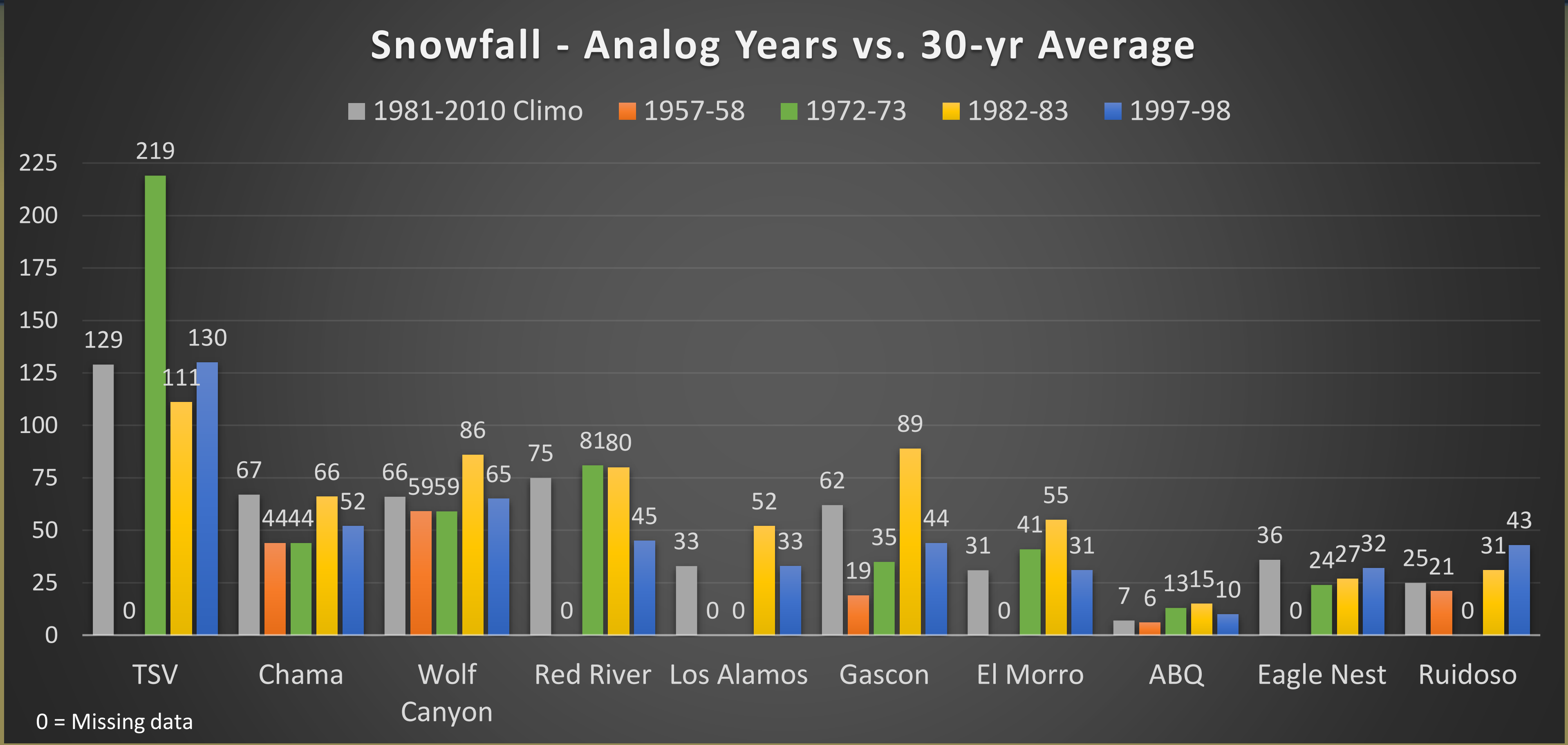


Figure 9. DJF snowfall from selected sites comparing very strong-extreme El Niño events with 1981-2010 climatological averages. Higher elevation sites received near to well above average snowfall whereas lower elevations sites varied considerably from one very strong-extreme El Niño to the next. Taos Ski Valley (TSV) had its snowiest season on record during the very strong El Niño of 1972-73.

DJF Precipitation – Analog Years vs. 30-yr Average

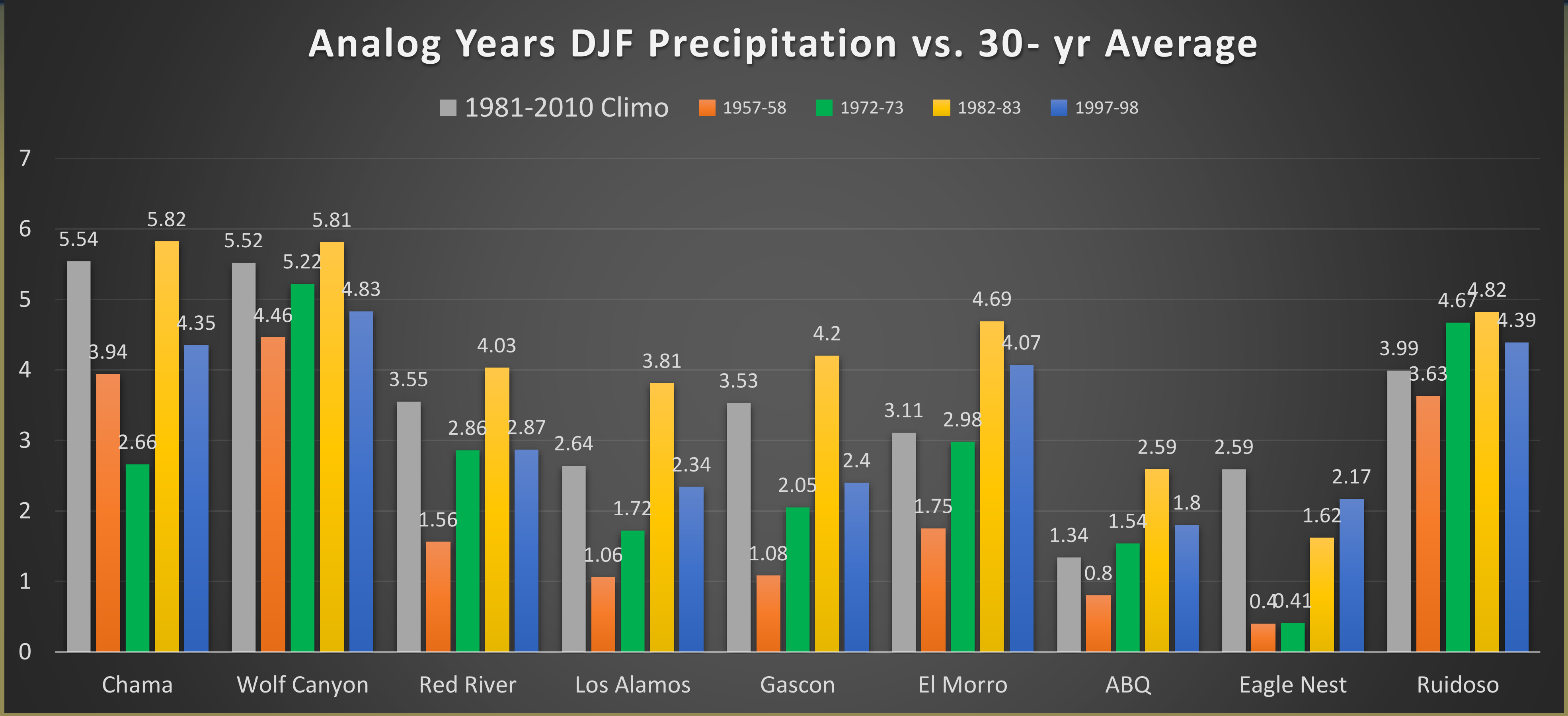
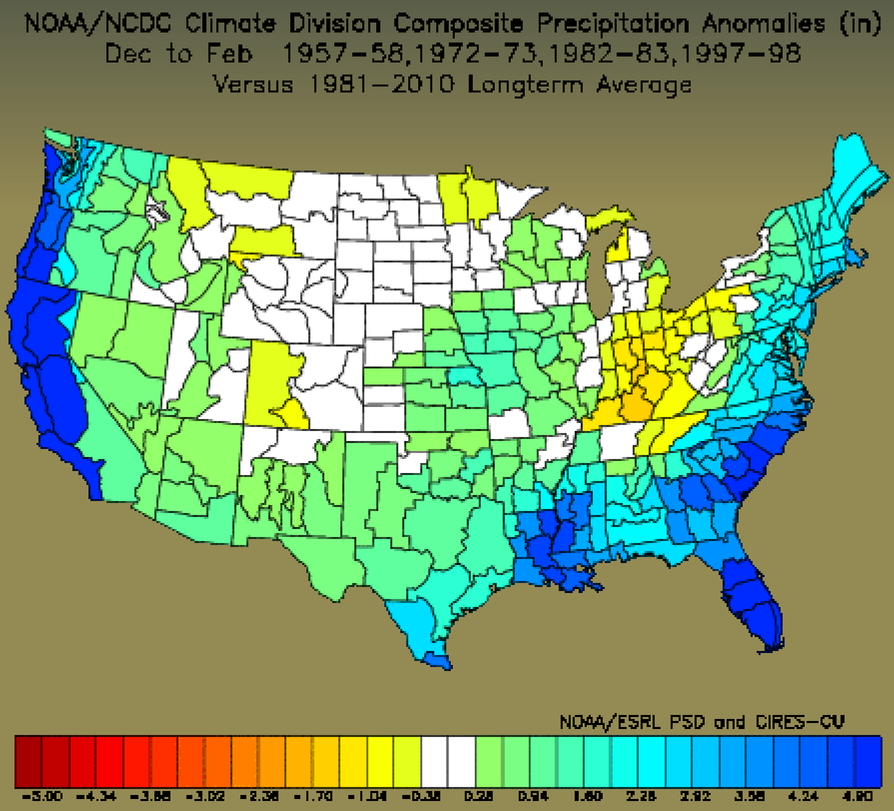
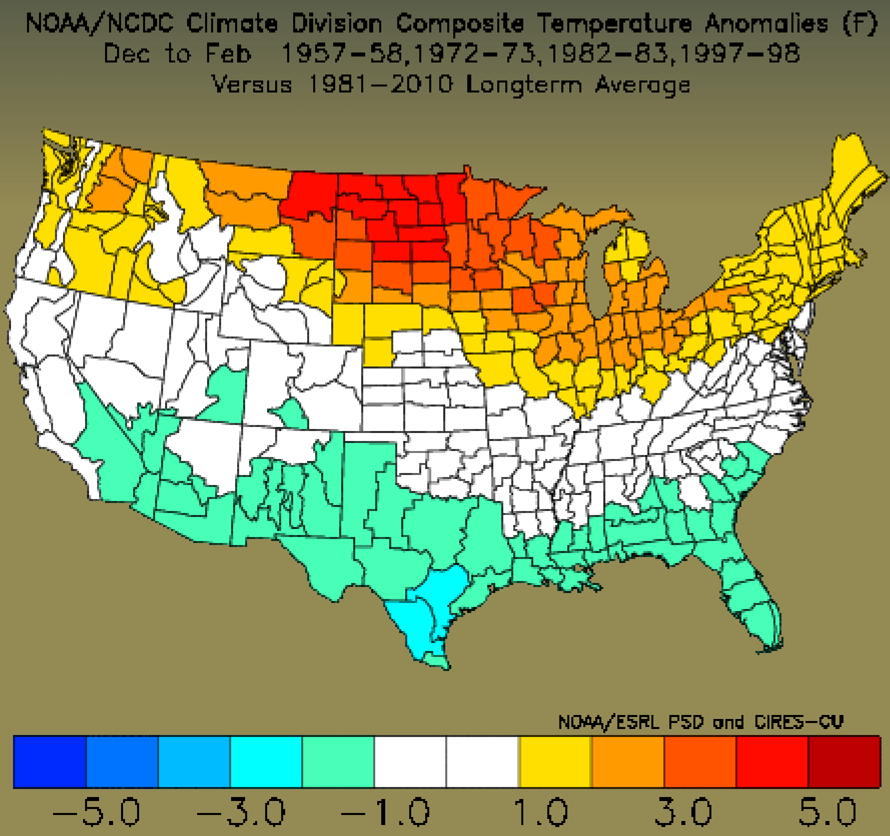


Figure 10. DJF precipitation from selected sites comparing very strong-extreme El Niño years to the 1981-2010 climatological average. Interestingly, the 1982-83 El Niño was the only very strong-extreme event during a positive PDO where above average precipitation fell at every site with the exception of Eagle Nest.

Precipitation and Temperature Anomalies





Figures 11 & 12 . DJF Precipitation and Temperature anomaly plots for CPC's climate divisions comparing the four strong/extreme El Niño years (1957-58, 1972-73, 1982-83 & 1997-98) with 30-year climatological averages. Six of the eight climate divisions in the state were slightly above average for precipitation while the same climate divisions were slightly below average with regard to temperature.

Precipitation and Temperatures During All El Niño DJFs Since 1950

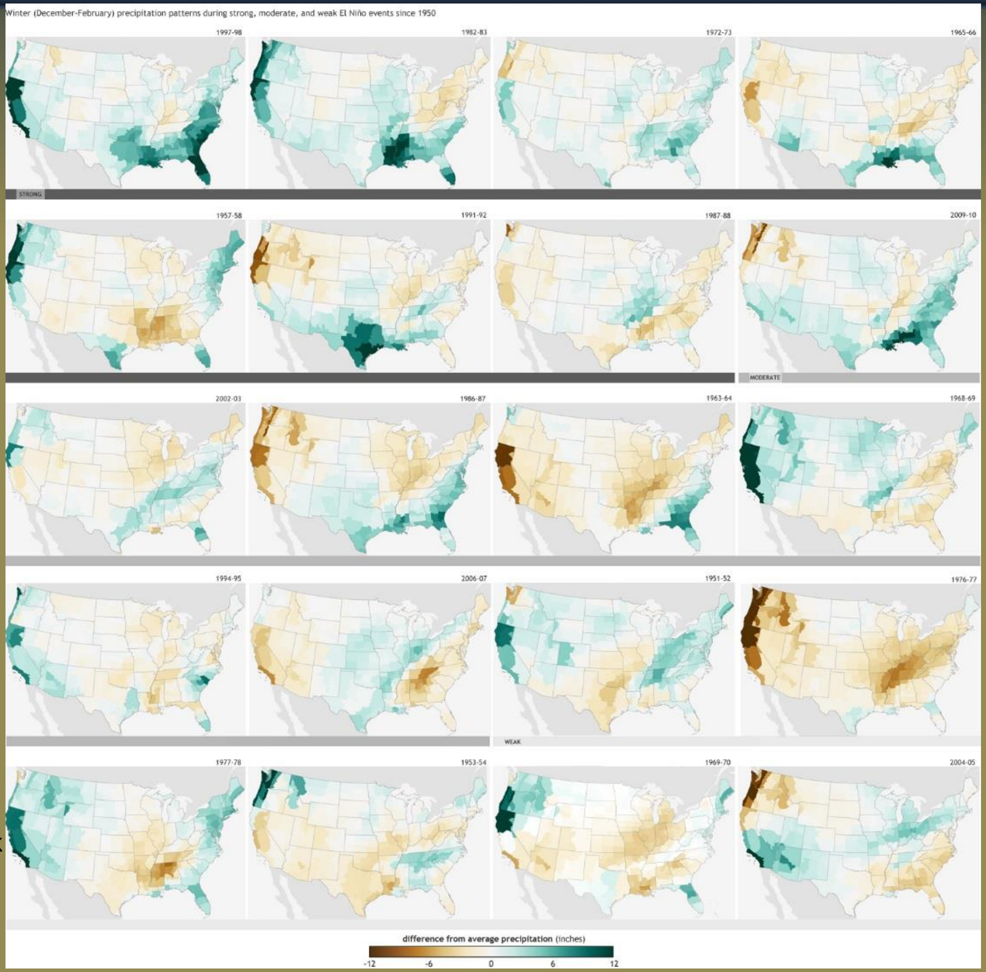
Very strong-extreme

Strong

Moderate

Weak-Moderate

Weak



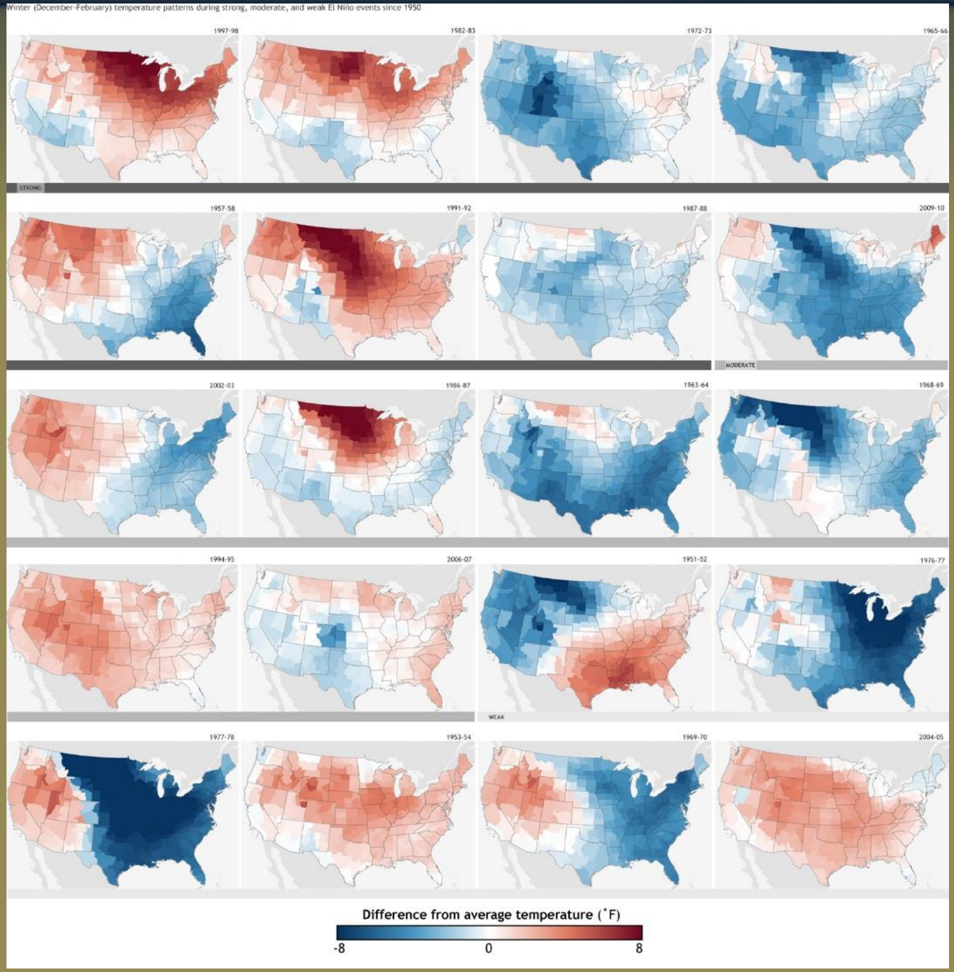
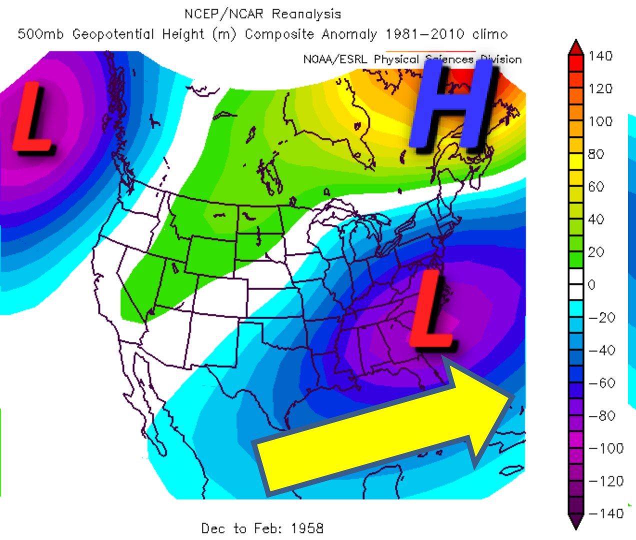
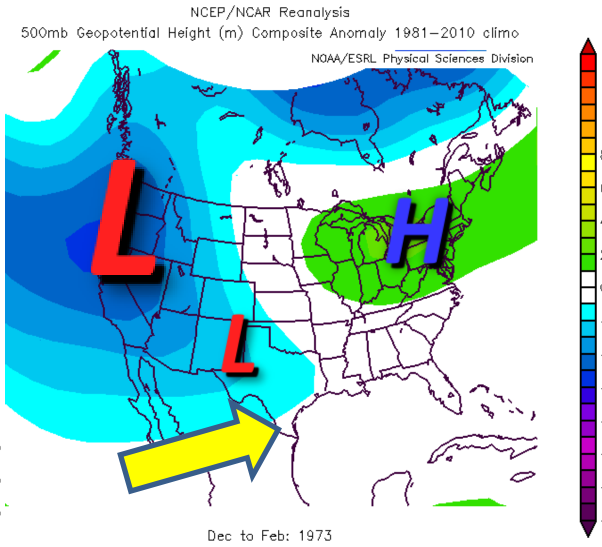


Figure 13 & 14. DJF precipitation and temperature anomalies during very strong-extreme, strong, moderate, and weak El Niño events since 1950. Note that precipitation during three of the four most analogous events to 2015, 1972-73, 1982-83, and 1997-98 were above average across much of New Mexico. 1957-58 is thought to be somewhat unrepresentative due to the lack of reliable precipitation data across the state. Click on an image to go to the climate.gov website to view zoomed in images.

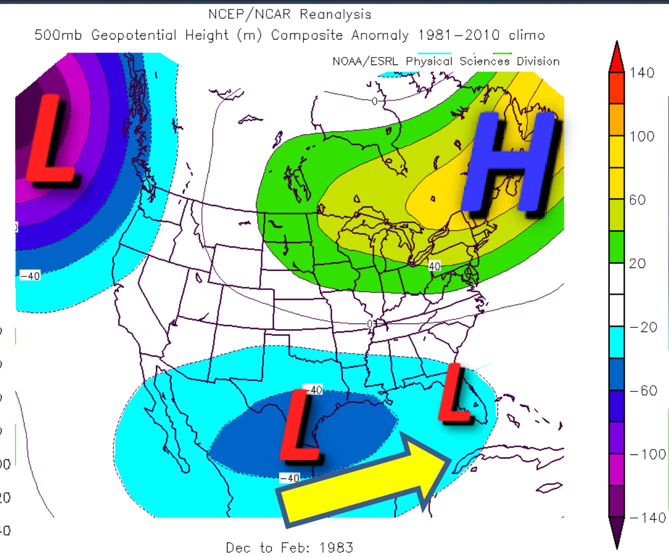
Differences Between 1957-58, 1972-73, 1982-83 & 1997-98



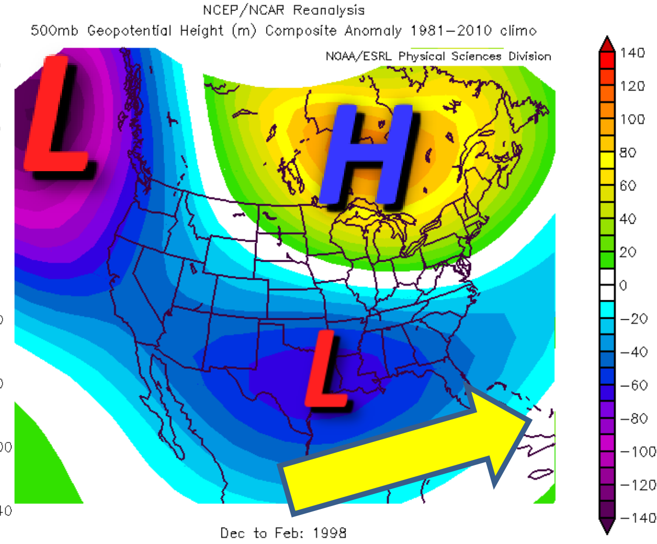
AUG-SEPT MEI = 1.18	SEPT PDO = 1.59	SEPT AMO = 0.231



AUG-SEPT MEI = 1.51	SEPT PDO = -0.17	SEPT AMO = 0.231



AUG-SEPT MEI = 1.51	SEPT PDO = 0.96	SEPT AMO = -0.120



AUG-SEPT MEI = 3.01	SEPT PDO = 2.19	SEPT AMO = 0.030

2015

AUG-SEPT MEI = 2.53	**SEPT PDO = 1.94**	**SEPT AMO = 0.320**

Figures 15-18. 500mb Height Anomalies from December-February 1957-58, 1972-73, 1982-83 & 1997-98. Note that the upper level height pattern/storm track between the very strong (1957-58 & 1972-73) to extreme (1982-83 & 1997-98) El Niño events varied greatly. Current SSTAs in the Pacific and Atlantic Ocean Basins are somewhere in between 1982-83 and 1997-98.

Latest Climate Model Forecasts

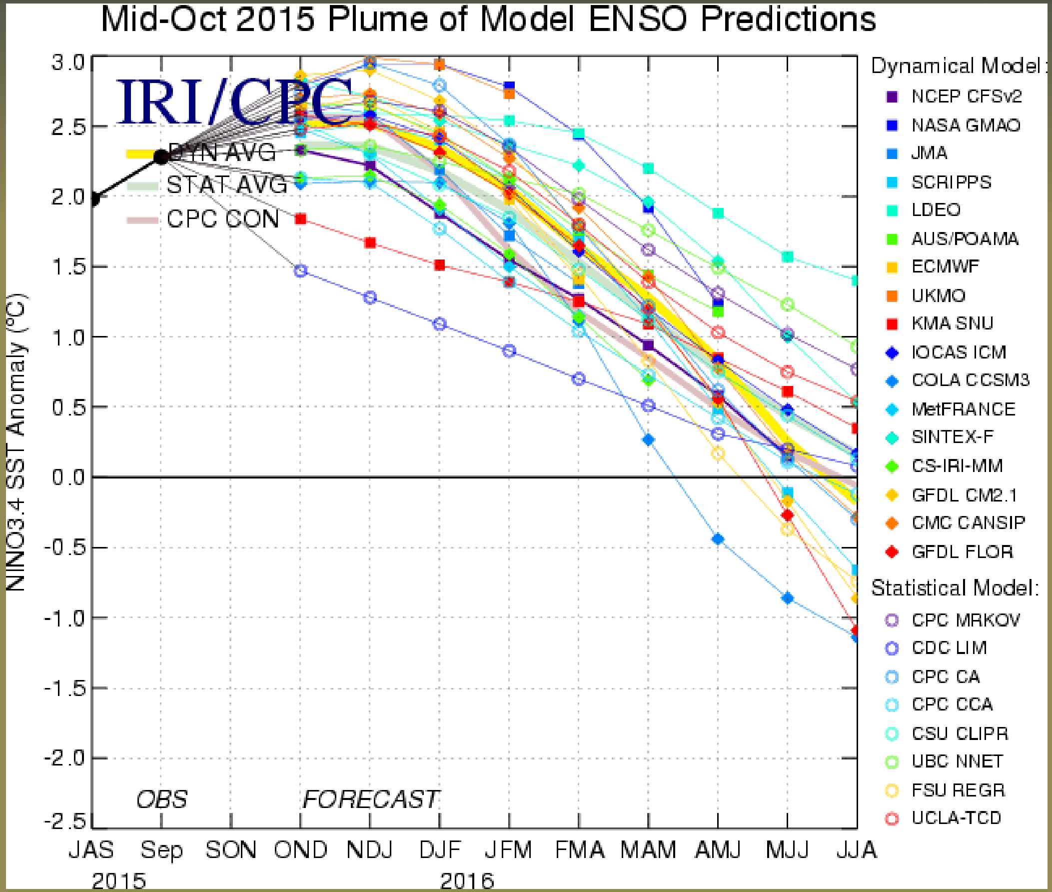
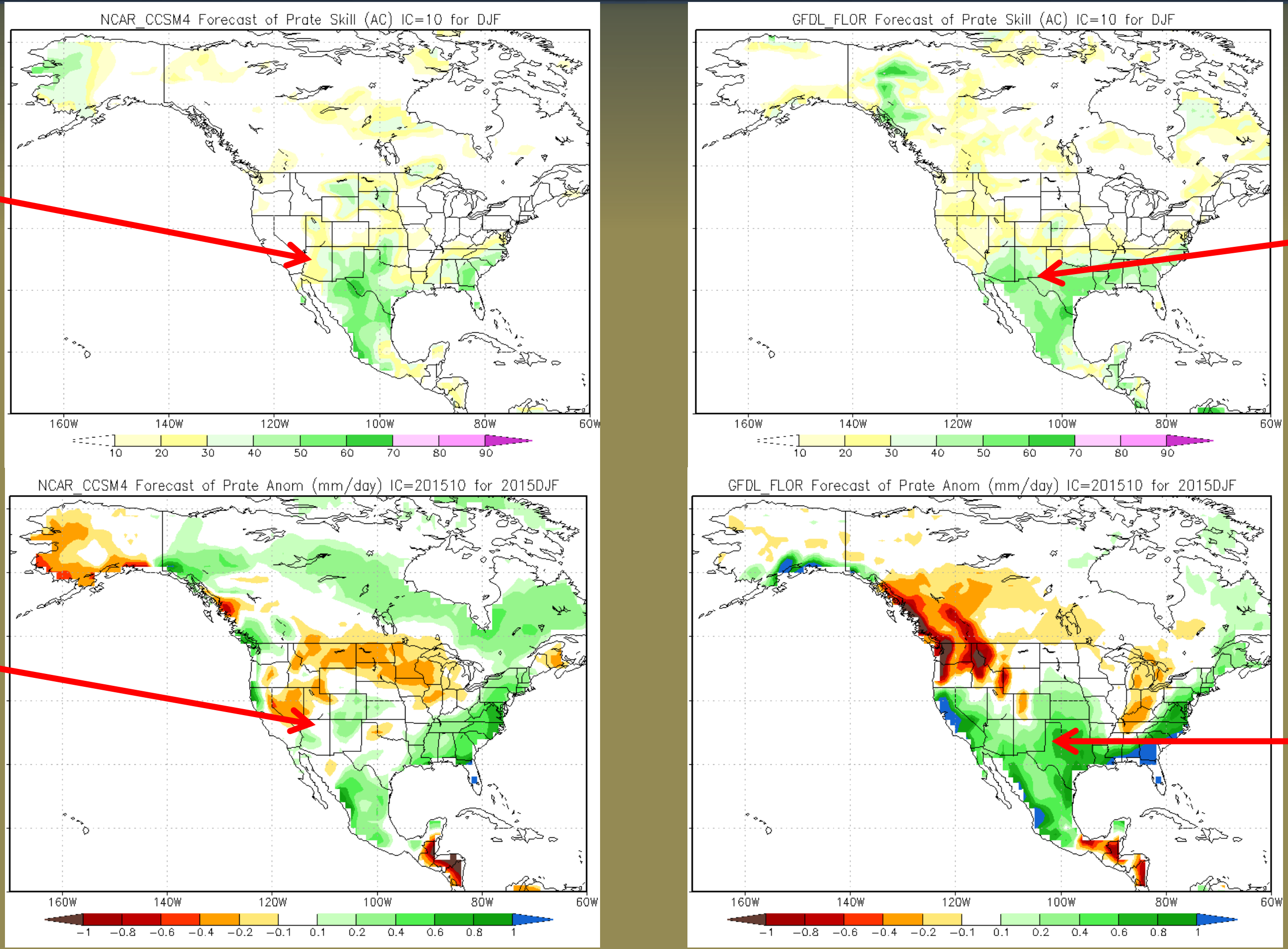


Figure 19. The vast majority of climate prediction models continue the very strong to extreme El Niño through early winter 2015-16, weakening it in late winter or early spring 2016.

Numerical Climate Prediction Model Output for DJF

Highest model skill in DJF over far W Texas and southern NM.

Highest model skill in DJF over much of Mexico, southeast AZ and southwest NM.

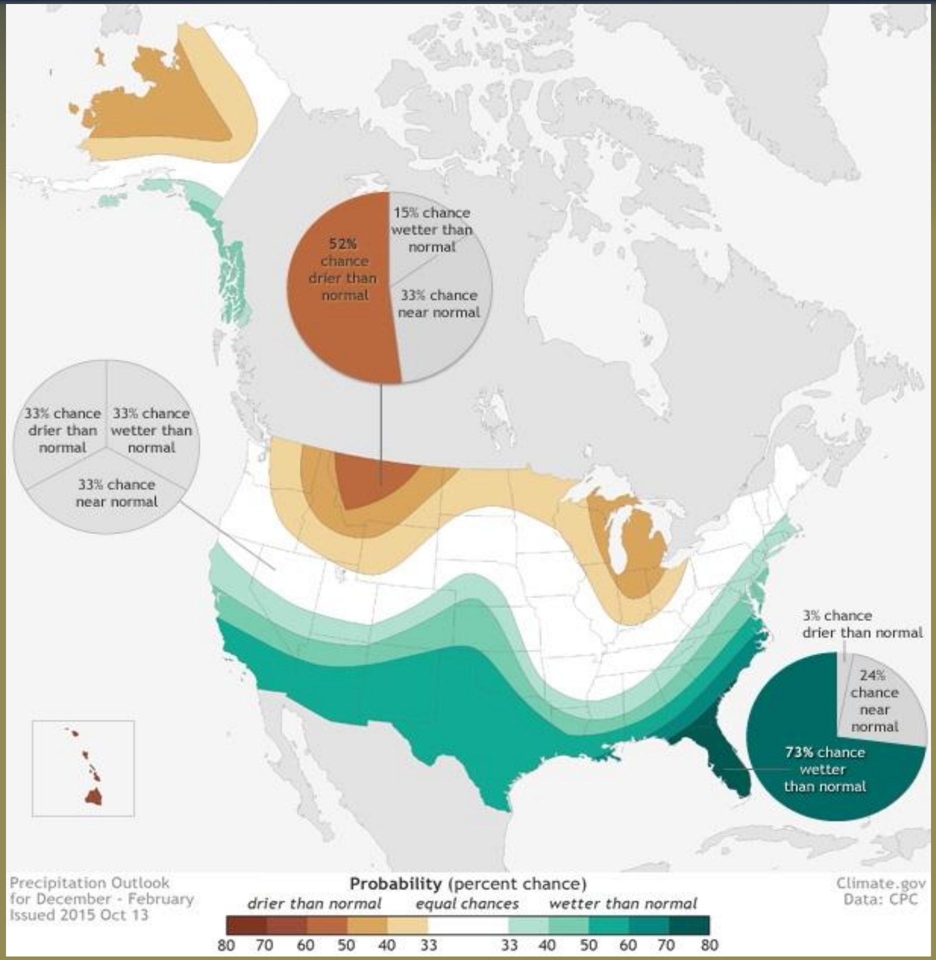


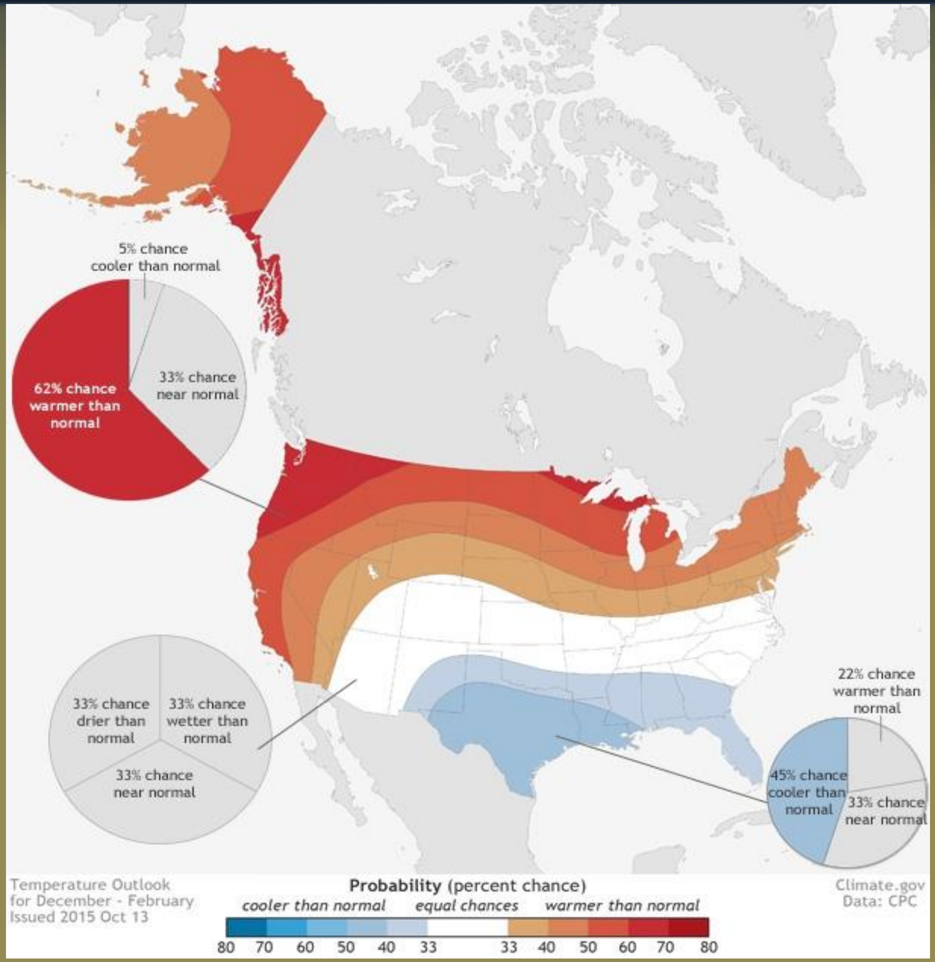
Light green equates to slightly above average precipitation rates.

Light Green to Green equates to slightly above to above average precipitation rates.

Figures 20-23. Model precipitation rate anomaly plots from the two climate models which have the highest skill percentages (top two images), the National Center for Atmospheric Research's Community Climate Model Version 4 and the Geophysical Fluid Dynamics Laboratory Florida State University (GFDL_Florida) model. Both models are forecasting either slightly above average to above average precipitation rates during DJF 2015-16 over New Mexico. GFDL Florida model favors central and southern NM and is closer to the two most analogous years (1982-83 & 1997-98) whereas the NCAR model favors northern NM.

Climate Prediction Center’s Official DJF Outlook





Figures 24-25. CPC’s DJF 2015-16 precipitation and temperature forecasts favoring above average precipitation and slightly greater than typical chances for temperatures to be below average over southeastern New Mexico.

Summary

- Precipitation (both rain and snow) in previous Winter (DJF) seasons during the onset years of a strong/extreme El Niño events since 1950 ranged from near to above the 1981-2010 climatological averages at sites throughout northern and central New Mexico. Keep in mind that many of the precipitation anomaly graphics shown in this outlook are typically used for wetter climates. In other words, despite precipitation in New Mexico being above to well above average, Figure 13 would suggest that precipitation in New Mexico is only slightly above average based on a color curve intended for wetter climates. Past precipitation data also suggests that the southern half of New Mexico is favored during very strong to extreme El Niño events.

- Precipitation data from the four most analogous years to 2015 (1957-58, 1972-73, 1982-83, and 1997-98) combined with forecasts from the most highly skilled climate forecast models indicate that precipitation in central and northern New Mexico during December, January and February (DJF) 2015-16 will most likely range from slightly above to above 1981-2010 climatological averages.

- Snowfall data from the four previous strong to extreme El Niño events combined with climate model forecasts suggest that snowfall will range from slightly above to above average in DJF 2015-16, particularly in the higher elevations favored by orographic effects.

- Keep in mind that each El Niño event is different. The two strongest El Niño events on record, 1982 and 1997, were significantly different from one another. Current observations of low level trade winds and SSTs suggest that this event will be somewhere in-between the 1982 and 1997 events.

Outlook Information

- **Outlook provided by National Weather Service Forecast Office Albuquerque, NM.**
- **For further information contact Andrew Church: andrew.church@noaa.gov (505) 244-9150**